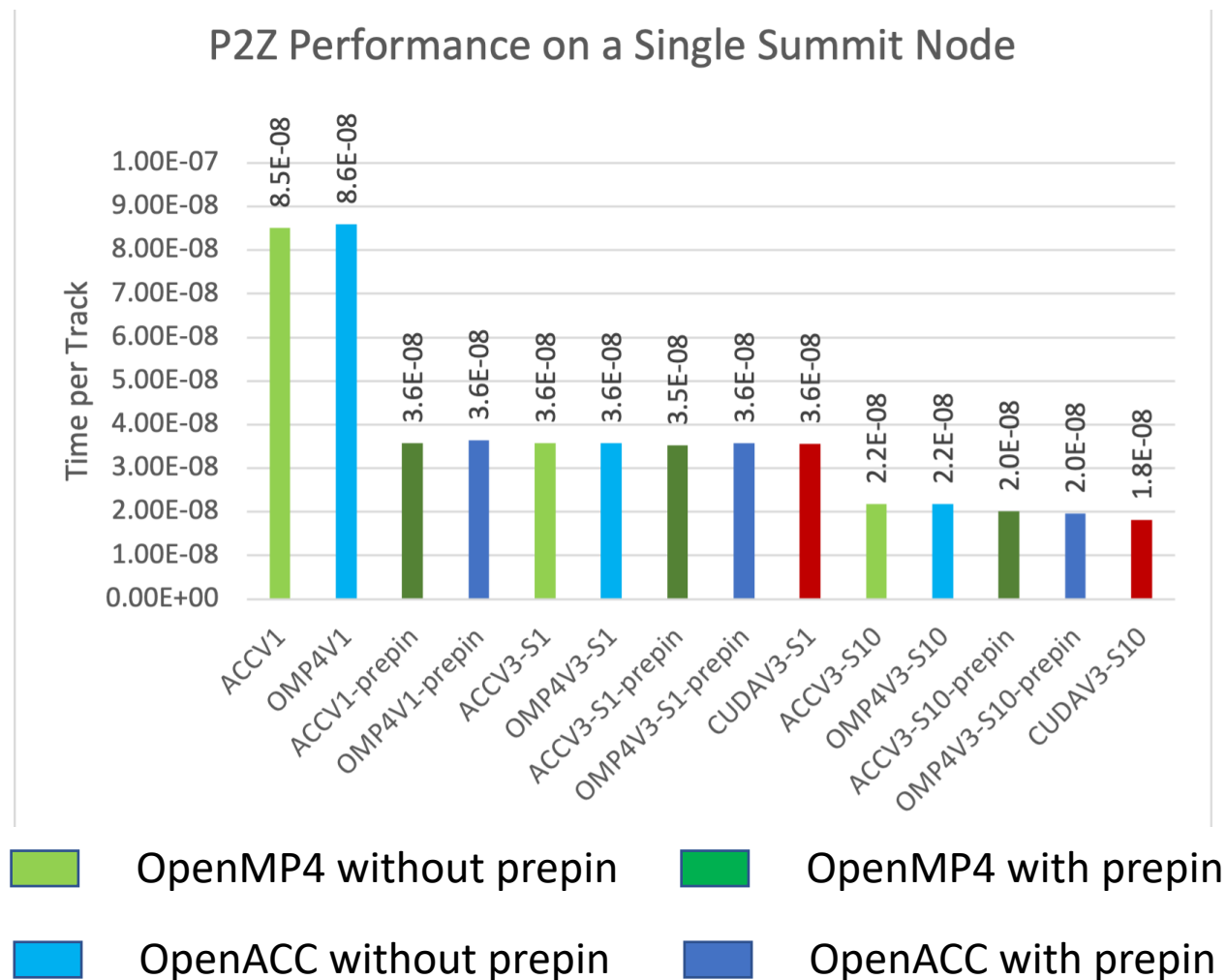# OpenACC vs. OpenMP4
P2Z Performance Comparison

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P2Z Performance: OpenACC, OpenMP4, and CUDA Performance on a Summit Node
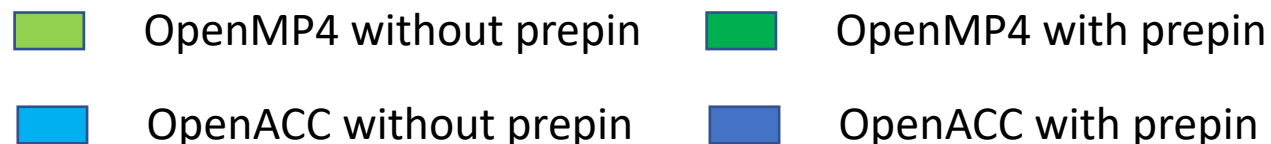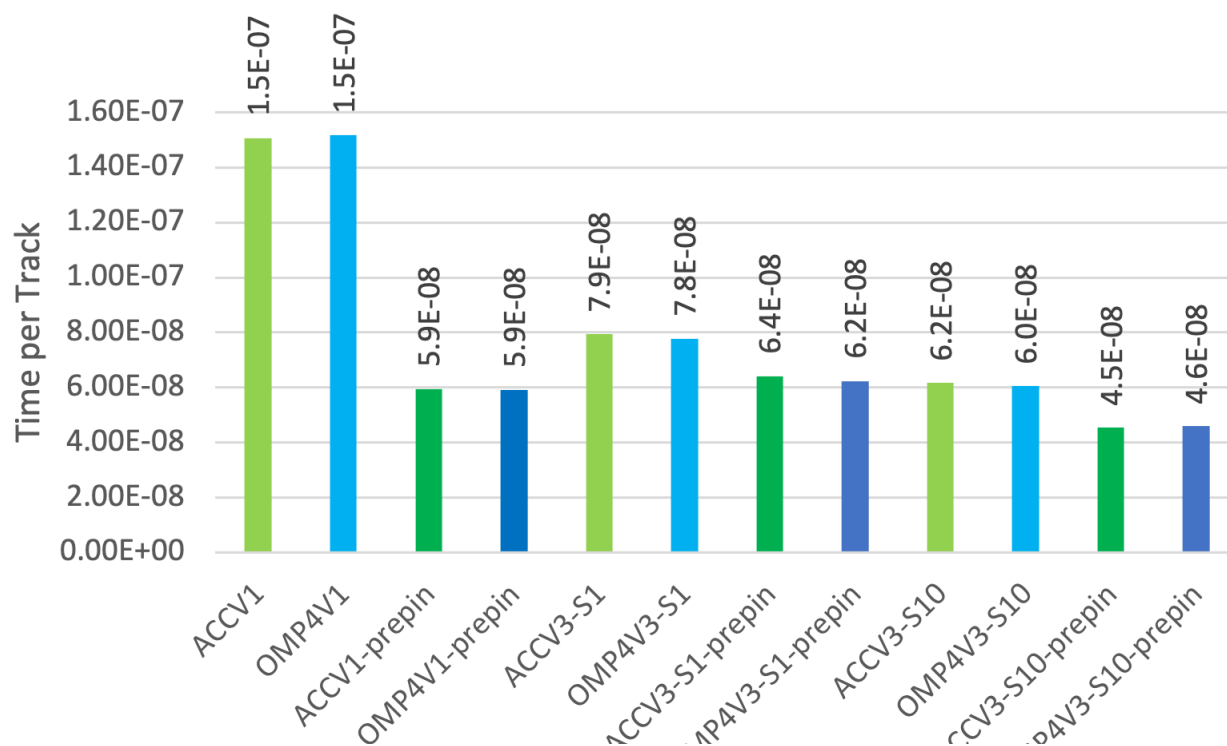

P2Z Performance on a Single Summit Node

- **ACCV1**: OpenACC Version 1 – Synchronous
- **OMP4V1**: OpenMP4 Version 1 – Synchronous
- **ACCV1-prepin**: OpenACC Version 1 – Synchronous & prepinned host memory
- **OMP4V1-prepin**: OpenMP4 Version 1 – Synchronous & prepinned host memory
- **ACCV3-S1**: OpenACC Version 3 – Asynchronous with 1 stream
- **OMP4V3-S1**: OpenMP4 Version 3 – Asynchronous with 1 stream
- **ACCV3-S1-prepin**: OpenACC Version 3 – Asynchronous with 1 stream & prepinned host memory
- **OMP4V3-S1-prepin**: OpenMP4 Version 3 – Asynchronous with 1 stream & prepinned host memory
- **CUDAV3-S1**: CUDA Version 3 – Asynchronous with 1 stream
- **ACCV3-S10**: OpenACC Version 3 – Asynchronous with 10 streams
- **OMP4V3-S10**: OpenMP4 Version 3 – Asynchronous with 10 streams
- **ACCV3-S10-prepin**: OpenACC Version 3 – Asynchronous with 10 streams & prepinned host memory
- **OMP4V3-S10-prepin**: OpenMP4 Version 3 – Asynchronous with 10 streams & prepinned host memory
- **CUDAV3-S10**: CUDA Version 3 – Asynchronous with 10 streams

V1: Sync version   **V3**: Async version

P2Z Performance: OpenACC vs. OpenMP4 Performance on an AMD Node

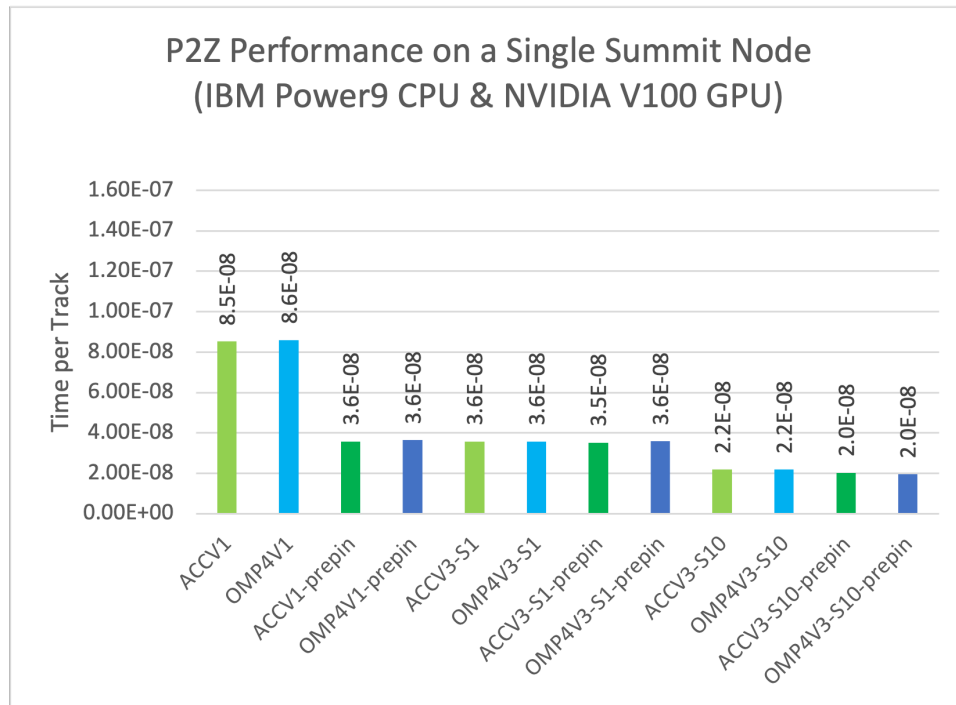(AMD EPIC 7272 CPU & AMD Instinct MI100 GPU)

- **ACCV1**: OpenACC Version 1 – Synchronous
- **OMP4V1**: OpenMP4 Version 1 – Synchronous
- **ACCV1-prepin**: OpenACC Version 1 – Synchronous & prepinned host memory
- **OMP4V1-prepin**: OpenMP4 Version 1 – Synchronous & prepinned host memory
- **ACCV3-S1**: OpenACC Version 3 – Asynchronous with 1 stream
- **OMP4V3-S1**: OpenMP4 Version 3 – Asynchronous with 1 stream
- **ACCV3-S1-prepin**: OpenACC Version 3 – Asynchronous with 1 stream & prepinned host memory
- **OMP4V3-S1-prepin**: OpenMP4 Version 3 – Asynchronous with 1 stream & prepinned host memory
- **CUDAV3-S1**: CUDA Version 3 – Asynchronous with 1 stream
- **ACCV3-S10**: OpenACC Version 3 – Asynchronous with 10 streams
- **OMP4V3-S10**: OpenMP4 Version 3 – Asynchronous with 10 streams
- **ACCV3-S10-prepin**: OpenACC Version 3 – Asynchronous with 10 streams & prepinned host memory
- **OMP4V3-S10-prepin**: OpenMP4 Version 3 – Asynchronous with 10 streams & prepinned host memory
- **CUDAV3-S10**: CUDA Version 3 – Asynchronous with 10 streams
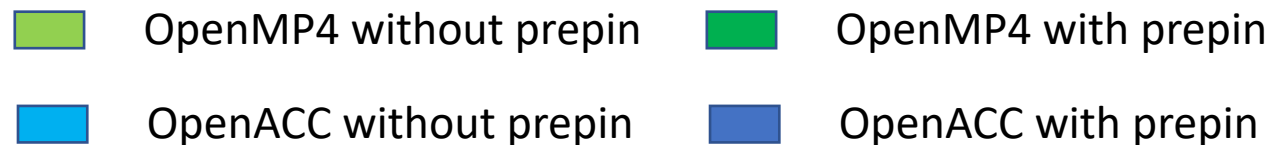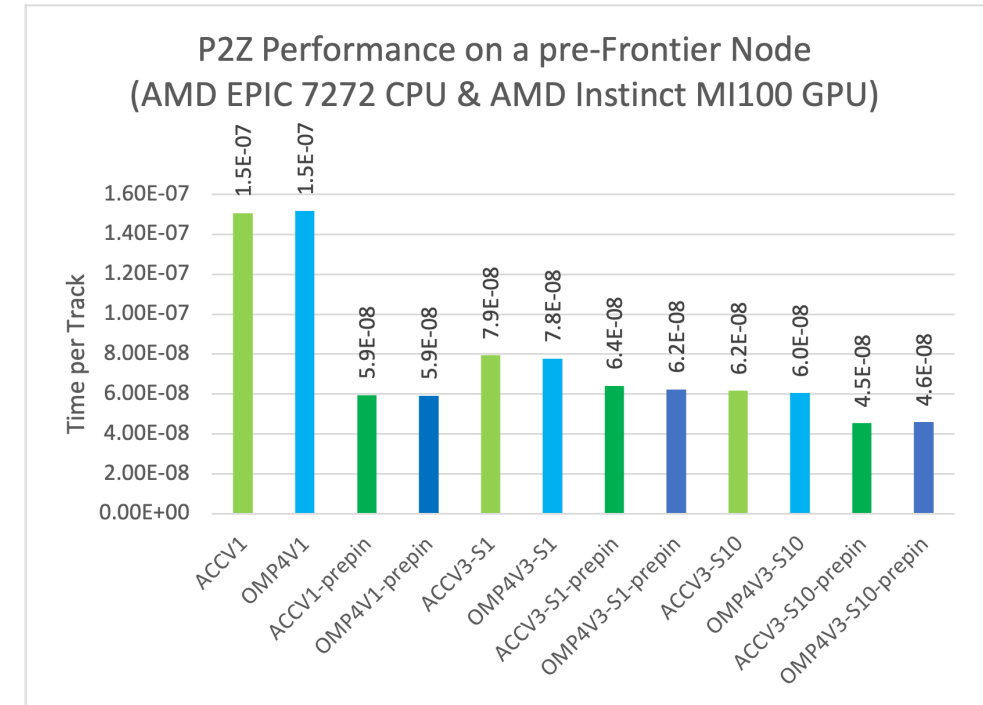
V1: Sync version   **V3**: Async version

P2Z Performance: NVIDIA V100 vs. AMD MI100

V100 Peak FP32 Performance: 15.7 TFLOPs

MI100 Peak FP32 Performance: 23.1 TFLOPs

P2Z Performance on a Single Summit Node
(IBM Power9 CPU & NVIDIA V100 GPU)

P2Z Performance on a pre-Frontier Node
(AMD EPIC 7272 CPU & AMD Instinct MI100 GPU)

OpenMP4 without prepin   OpenMP4 with prepin

OpenACC without prepin   OpenACC with prepin
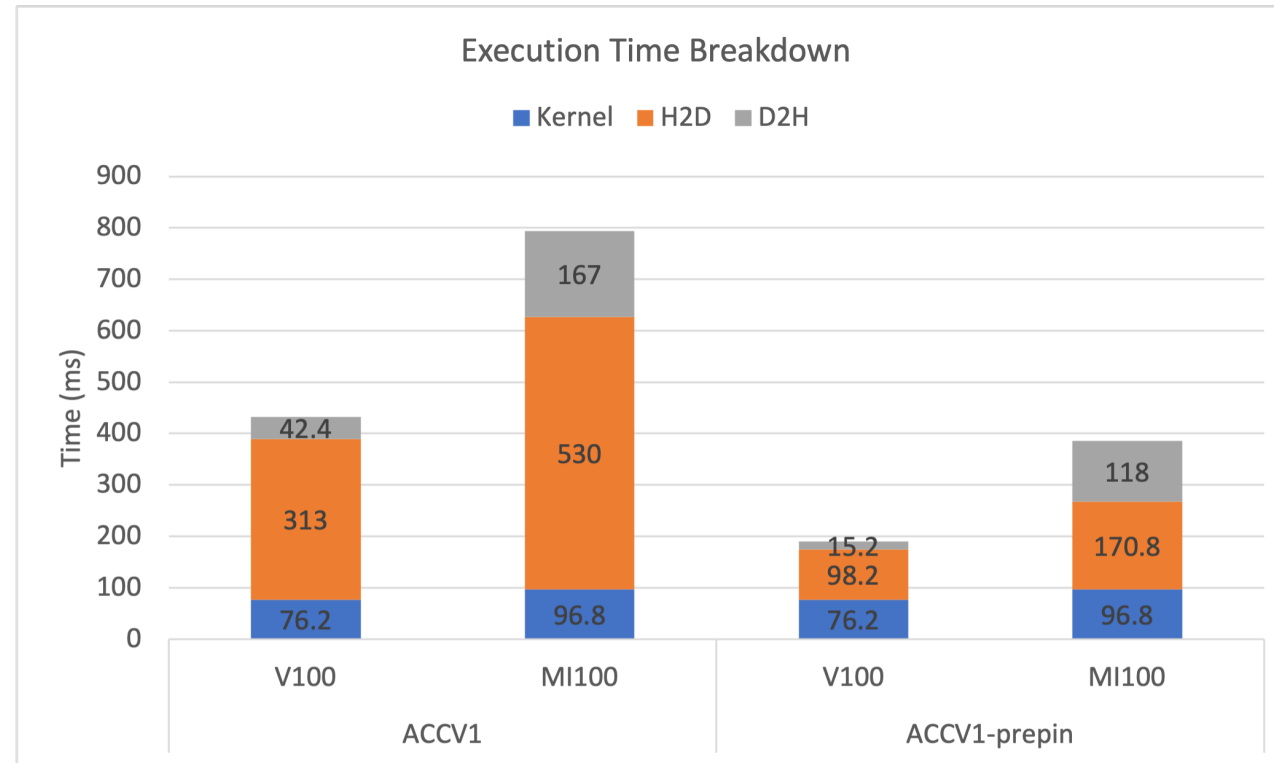
V1: Sync version   **V3**: Async version

P2Z OpenACC V1 Execution Time Breakdown

OpenACC V1 is a synchronous version

Summit Node (Power 9 CPU + V100 GPU): V100 FP32 Peak Performance = 15.7 TFLOPs
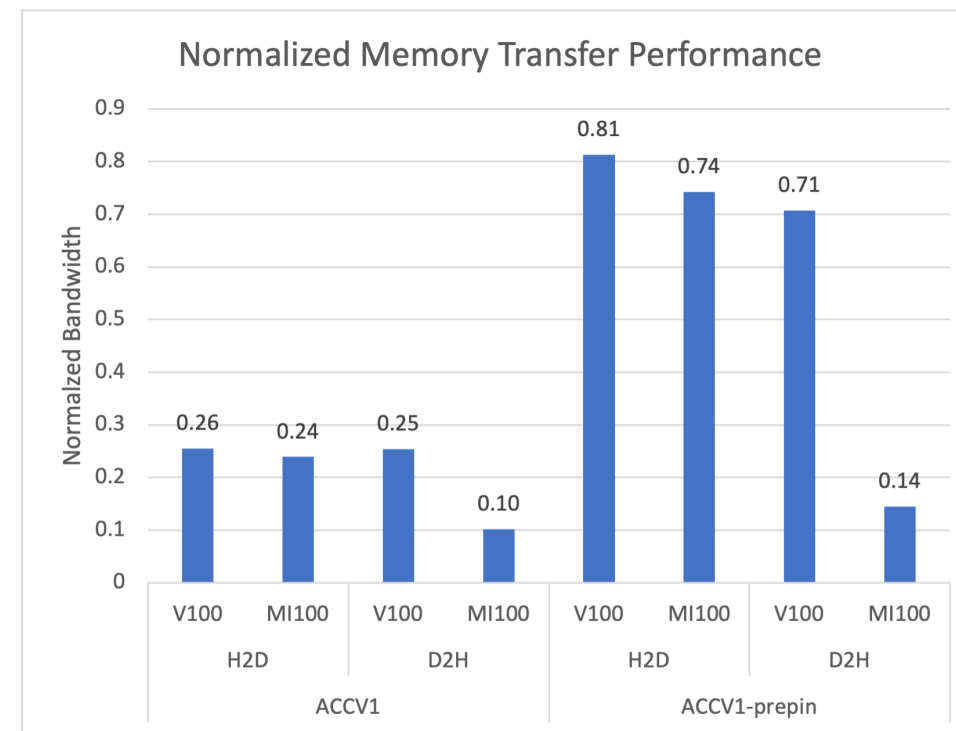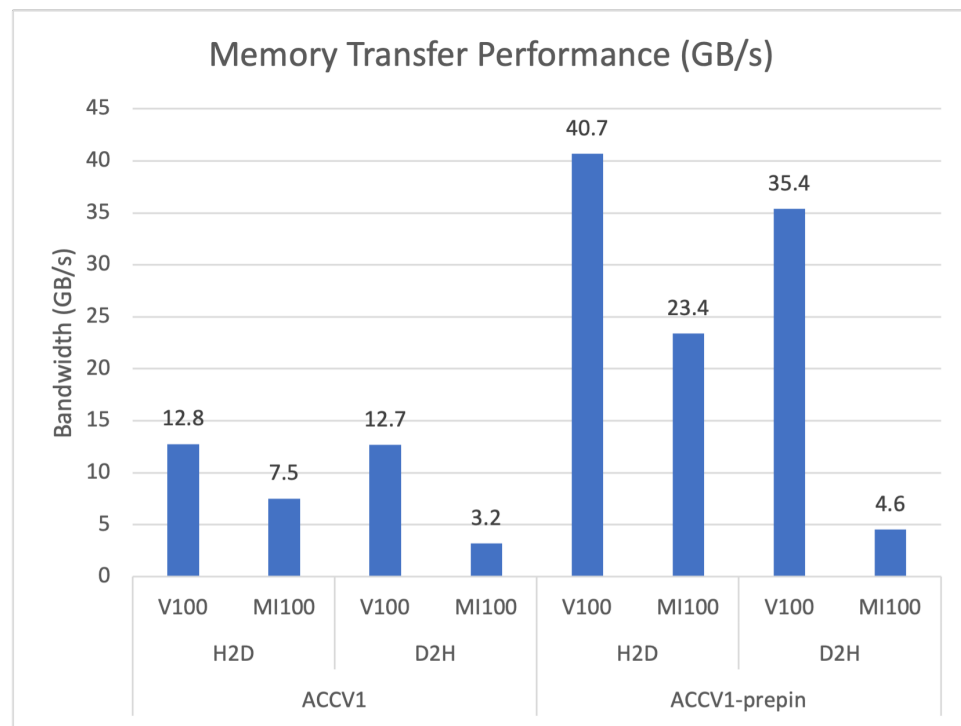CPU-GPU connection: NVLINK (50 GB/s)
AMD Node (EPIC7272 CPU + MI100 GPU): MI100 FP32 Peak Performance = 23.1 TFLOPs
CPU-GPU connection: PCI-e x16 (31.5 GB/s)

Memory Transfer Performance Comparison

Total H2D Transfer Size: 3.8 GB   Total D2H Transfer Size: 0.525 GB

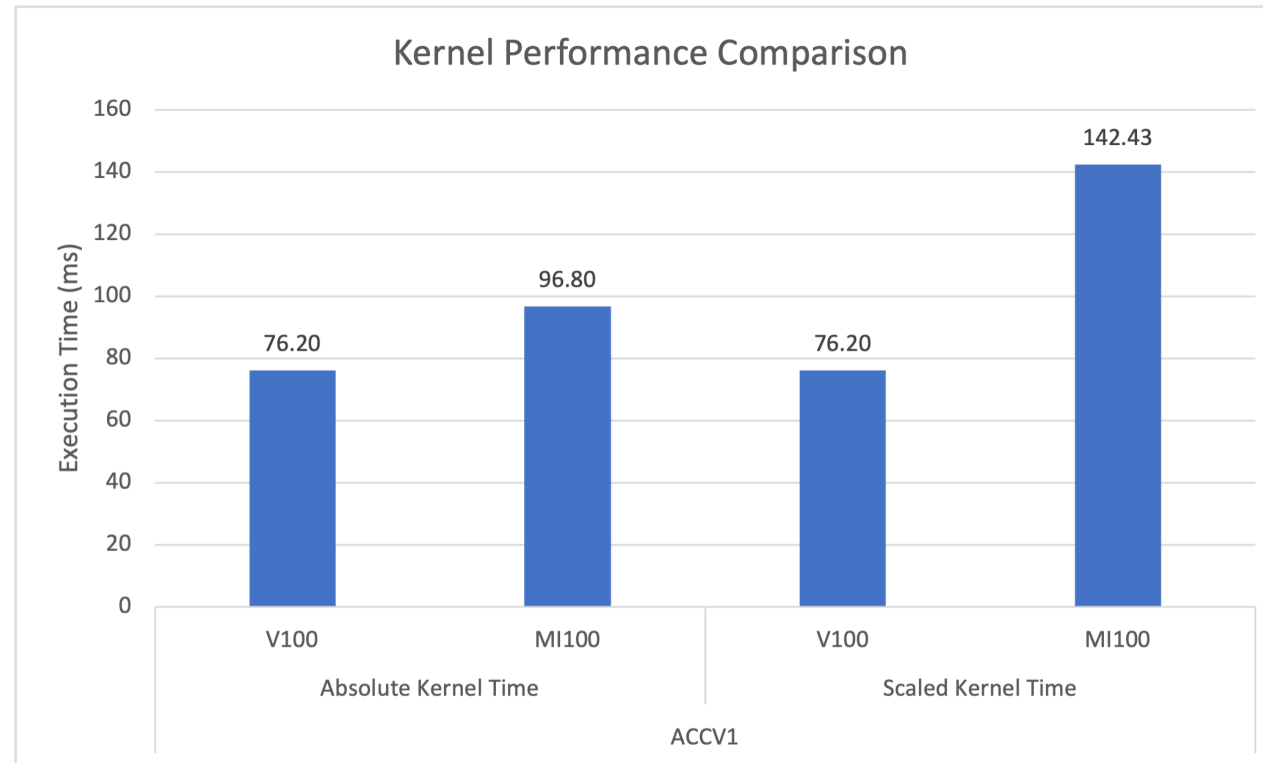Normalized against the peak communication bandwidth

Summit Node (Power 9 CPU + V100 GPU): V100 FP32 Peak Performance = 15.7 TFLOPs
CPU-GPU connection: NVLINK (50 GB/s)
AMD Node (EPIC7272 CPU + MI100 GPU): MI100 FP32 Peak Performance = 23.1 TFLOPs
CPU-GPU connection: PCI-e x16 (31.5 GB/s)

Kernel Performance Comparison

Scaled kernel time of MI100 is the estimation when assuming MI100 has the same FP32 peak performance as V100 (15.7 TFLOPs).

Summit Node (Power 9 CPU + V100 GPU): V100 FP32 Peak Performance = 15.7 TFLOPs
CPU-GPU connection: NVLINK (50 GB/s)
AMD Node (EPIC7272 CPU + MI100 GPU): MI100 FP32 Peak Performance = 23.1 TFLOPs
CPU-GPU connection: PCI-e x16 (31.5 GB/s)